

# SCENES FROM A DEMONSTRATION: MERGING THE BENEFITS OF PAPER NOTEBOOKS WITH THE POWER OF COMPUTERS IN DYNAMITE

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### ABSTRACT

Dynomite is a portable electronic notebook that merges the benefits of paper note-taking with the organizational capabilities of computers. Dynomite incorporates four complementary features which combine to form an easy to use system for the capture and retrieval of handwritten and audio notes. First, Dynomite has a paper-like user interface. Second, Dynomite uses ink properties and keywords for content indexing of notes. Third, Dynomite's properties and keywords allows retrieval of specific ink and notes. The user is shown a view, or a subset of the notebook content, that dynamically changes as new information is added. Finally, Dynomite continuously records audio, but only permanently stores highlighted portions so that it is possible to augment handwritten notes with audio on devices with limited storage.

### Keywords

Electronic notebook, note-taking, audio, handwriting, keyword indexing, ink properties, retrieval, paper-like interfaces, pen computing.

### INTRODUCTION

Dynomite is a portable electronic notebook for the capture and retrieval of handwritten and audio notes. We combine the best of both worlds: the freeform input of paper, and the search and organizational capabilities of computers. Whereas PDAs and portable computers redefine the note-taking process, Dynomite enhances traditional paper note-taking.

As part of the design process we observed how people use paper notebooks [6]. This helped us understand the affordances of paper where freeform input, spatial layout, and even doodles (for their visual cues) are an integral part of the note-taking process. The study pointed out ways we could improve the note-taking process, and generated the following design goals for a portable electronic notebook:

1. match the ease of use of paper notebooks, including freeform input

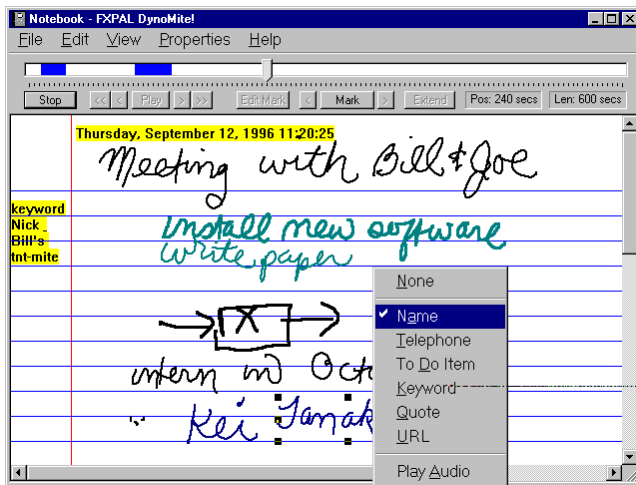
2. obtain keys for indexing while maintaining a low cognitive overhead note-taking process
3. support retrieval beyond the visual scanning provided by paper notebooks
4. record audio to augment handwritten notes

### DYNAMITE IMPLEMENTATION

Our current implementation runs on pen-based portable computers that support Windows 95 and Pen Windows. One characteristic of portable computers is their moderate storage capacity. Thus Dynomite must take a different approach to audio enhanced notes than other systems [1,4,5]. Another constraint on our design is that handwriting recognition is neither fast nor accurate and therefore distracts the user from the task at hand. Thus our system uses digital ink without interactive recognition. Consequently, in contrast to systems whose main input is text and whose index is keywords [3], we also provide indexing of the ink itself.

As stated above our first design goal was to match the ease of use of paper notebooks. Our ink based system supports freeform input on top of a screen with the appearance of a page in a traditional notebook, as shown in Figure 1. Pen strokes are clustered by time so that marks created sequentially without a pause are grouped together. In addition, a selection rectangle can be dragged out, selecting all groups in a region. These groups can then be cut, pasted, or moved around on the page.

Our second design goal was to provide a low cognitive overhead method for indexing. Because our input is digital ink we provide "properties" that index the ink itself. Properties are information types associated with selected ink, analogous to data types in a programming language. Our default properties include "To Do," "Telephone number," and "URL." Properties are effective because it is easier for people to identify and select the type of information (*e.g.*, "telephone number") than its content description (*e.g.*, "Lynn's telephone number"). Properties



**Figure 1: Dynomite notebook page showing ink properties and audio highlighted ink (in bold). Highlights are also shown as bars on the audio time line.**

are assigned to groups of strokes by selection from a pop-up context menu, as shown in Figure 1.

Dynomite also allows text keywords to be associated with a page of notes. This allows keyword based retrieval. In contrast to properties which reflect the type of information contained in the ink, keywords describe the content of the note.

The third design goal we address is retrieval of information from the notebook. A table of contents for browsing the notebook is shown in Figure 2. Each line gives information about a page of notes. The first two columns show the date that the note page was created and the date of last modification. Icons tell which properties are present in the note page. Finally, keywords associated with the page are listed. For example, in Figure 2, the first entry is a note created on September 12<sup>th</sup> and has a telephone number and person's name written. The note itself has the keyword "wireless." It is also possible to sort by any field, in order, for example, to find the most recently modified page, or to bring all pages with "To Do" items to the top of the list.

Typically users take notes chronologically on a number of topics and thus actually have a number of distinct topic threads occurring in one notebook. Dynomite has the ability to provide multiple views on the notebook, analogous to views in a database system. For example, requesting notes from last week with property "To Do" and keywords "mobile" and "computing" would cause the notebook to display only those notes from the previous week which were marked as "To Do" items and were on the topic of mobile computing. Once notebook views are defined they may be reused, providing the user with a dynamic organization of the changing content of the notebook.

Created	Modified	Properties	Keywords
09/12/96 11:10:31	09/12/96 11:10:31		wireless
09/12/96 11:08:06	09/12/96 11:08:06		audio
09/12/96 11:06:15	09/12/96 11:06:15		video

**Figure 2: A table of contents showing note pages' creation and modification date, properties (icons) and keywords.**

When enabled, audio is recorded continuously and time stamped synchronously with the pen strokes, similar to other systems [1,4]. However, since Dynomite is intended to run on mobile devices which do not have much storage, only those portions of the audio "highlighted" by the user are stored permanently. Degen *et al.* [2] designed an audio-only device that also uses audio marking. The audio toolbar (at the top of Figure 1) provides a visual display of the entire audio recording and the highlights within this period. During recording, user's can mark new highlights using a button or gesture. After recording, highlights can be played back or edited.

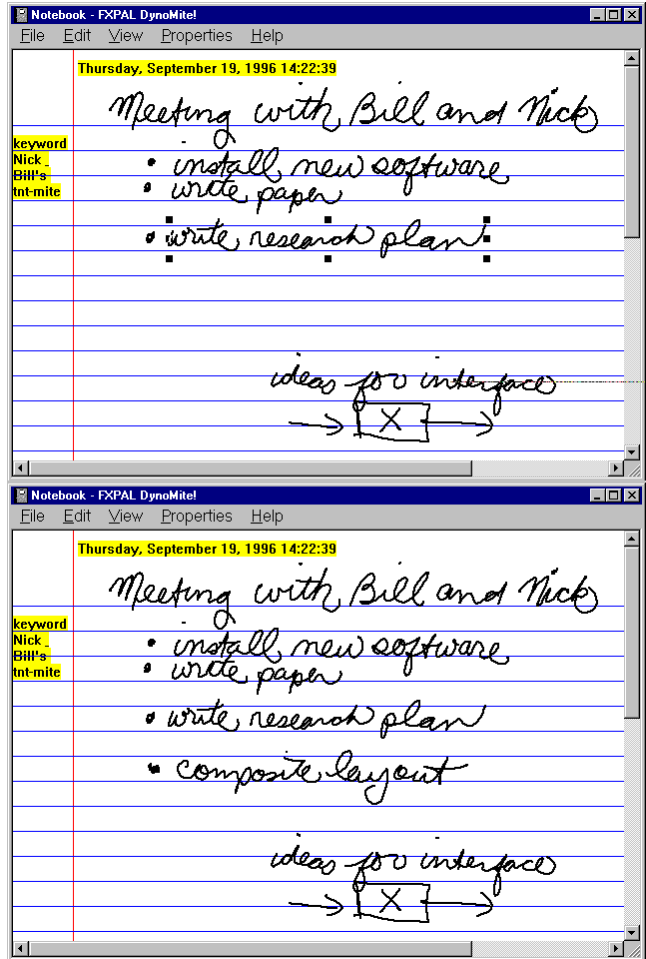
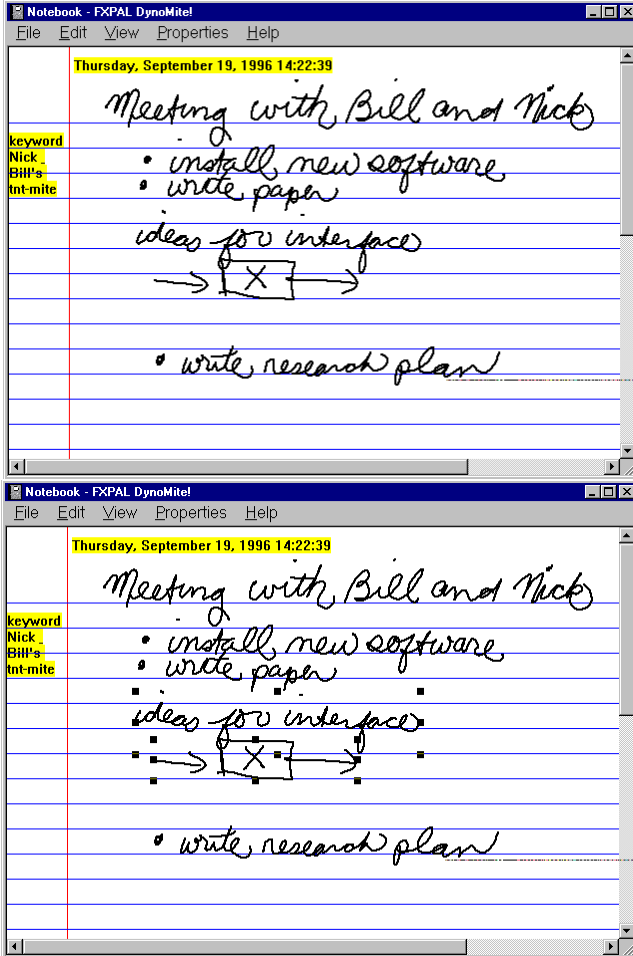
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# APPENDIX I: SCENES FROM A DEMONSTRATION

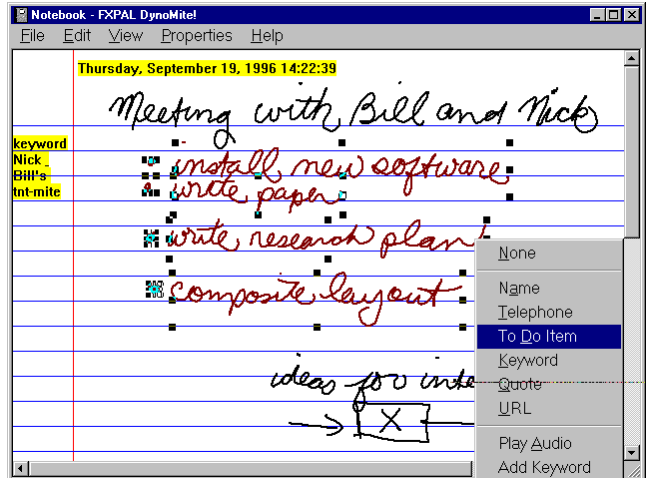
## Scene 1: Casual interface

This scene demonstrates the paper-like user interface. Various paper backgrounds can be selected. The user can draw anywhere on the screen with the pen. Ink can be edited using gestures and menus. You can select ink and move it around on the page. You can extend the size of the page.



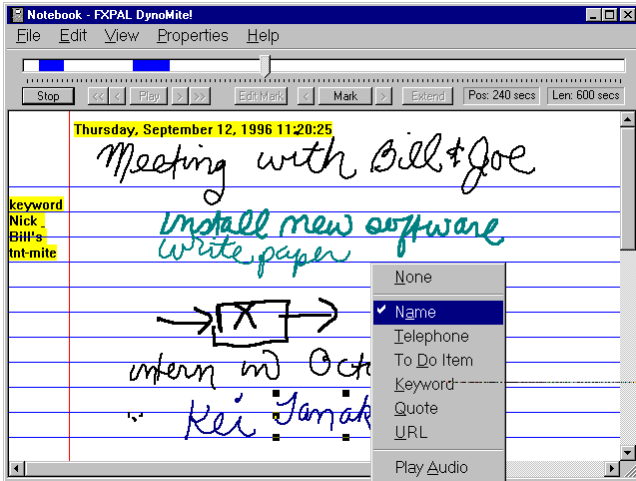
## Scene 2: Marking

Marking is the process by which properties and keywords are added. Properties are added selected ink, and keywords are added to the note page. These are used for later retrieval. Properties are assigned using a pop-up context menu. Properties have different ink colors (which are user configurable).



### Scene 3: Audio Recording and Highlighting

When audio is being recorded the user can highlight regions by pressing the “Mark” button or using a gesture. This starts a fixed period highlight of the audio. The duration of a highlight can be controlled by using the “Extend” button or the “End Mark” button. The audio timeline continually updates during recording to show color bars for each highlighted region. Ink written during an audio highlight is shown in bold.



### Scene 4: Audio highlight Review and Editing

This scene demonstrates the operation of the audio toolbar. During playback the user can skip from one highlight to another. Highlights can be edited by pushing the “Edit Mark” button and changing the end points. The user can expunge the non-highlighted audio after editing.



### Scene 5: Table of contents

This scene shows the table of contents tool for the notebook. The user can select a page in the notebook by clicking on it’s entry in the contents. The contents show creation and modification dates of each note page. Properties associated with ink on the page are also shown as icons. Keywords for the note page are listed in the last column. The user can sort the various columns bringing notes with particular properties to the top of the list.

Created	Modified			Keywords
09/12/96 11:10:31	09/12/96 11:10:31			wireless
09/12/96 11:08:06	09/12/96 11:08:06			<input checked="" type="checkbox"/> audio
09/12/96 11:06:15	09/12/96 11:06:15			video

### Scene 6: Views

This scene shows how properties and keywords are used to retrieve notebook content. This allows the user to create views on the notebook for any particular topic. The user does this by filling in the view query shown below. The user can also retrieve old views by name.

Appointment     Quotation    Enter key words: wireless  
 Name             To Do  
 Phone #           URL